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(54) SEALANT SYSTEM FOR AN INSULATING GLASS UNIT
DICHTUNGSSYSTEM FÜR EIN VERBUNDFENSTER
SYSTEME D'ETANCHEITE POUR UNITE DE VITRAGE ISOLANT

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Description

1. Field of the Invention

[0001] This invention relates generally to an insulating glass unit and, in particular, to a moisture impervious sealant system for an insulating glass unit and a method of making same.

2. Description of the Currently Available Technology

[0002] It is well recognized that insulating glass (IG) units reduce the heat transfer between the outside and inside of a building or other structure. Examples of IG units are disclosed in U.S. Patent Nos. 4,193,236; 4,464,874; 5,088,258; and 5,106,663 and European reference EP 65510.

[0003] A sealant system or edge seal structure of the prior art is shown in Fig. 1. The IG unit 10 of Fig. 1 includes two spaced apart glass sheets 12 and 13 adhesively bonded to a rigid spacer frame 14 by a sealant system 15 to provide a chamber 16 between the two glass sheets 12 and 13. The chamber 16 can be filled with a selected atmosphere, such as argon or krypton gas, to enhance the performance characteristics of the IG unit 10. The sealant system 15 bonding the glass sheets 12 and 13 to the spacer frame 14 are expected to provide structural strength to maintain the unity of the IG unit 10 and prevent gas leaking out of the chamber 16 or the atmosphere from outside the IG unit 10 from moving into the chamber 16. The sealant system 15 includes a layer 17 of moisture resistant sealant at the upper section of the spacer 14 to prevent the ingress and egress of gas into and out of the chamber 16 and a layer 18 of a structural type sealant, such as silicone to secure the sheets to the spacer. A moisture resistant sealant usually used in the art is polyisobutylene (PIB).

[0004] In addition to adhering the two glass sheets 12 and 13 to the spacer frame 14 and forming a moisture impervious barrier, the sealant system 15 should accommodate the natural tendency for the edges of the glass sheets 12 and 13 to rotate or flex due to changes in atmospheric pressure in the chamber 16 as a result of temperature, wind load and altitude changes, such as when an IG unit is manufactured at one altitude and installed at a different altitude. The spacer and selected sealant system should maintain the structural integrity of the IG unit as well as the sealing properties of the edge seal structure even during such changes.

[0005] As will be appreciated, box spacer frames 14, such as shown in Fig. 1, are not well suited for allowing such flexibility. For example and with reference to Fig. 2, as the distance between the sheets 12 and 13 increases because of pressure differences inside and outside of the chamber 16, the sealant system 15, in particular the layer 17 of the moisture resistant sealant, stretches and thins under stress, which decreases its ability to prevent atmospheric air from moving into and/or gas escape from the chamber16. With rigid, box spacer frames, the structural sealant system 15 tends to become over-stressed with time and fails prematurely. Additionally, the rigid spacer frame itself may become over-stressed and may collapse or deform or the glass sheets may become over-stressed at the edges and crack. Further, if the chamber between the glass sheets is filled with gas such as argon, krypton or other such insulating gas, the deformation of the sealants 17 and 18 and/or spacer frame 14 often results in accelerated loss of those gases from the chamber into the surrounding atmosphere.

[0006] An alternative to the prior art arrangement shown in Fig. 1 is to use a more flexible spacer frame, e.g. of the type disclosed in U.S. Patent Nos. 5,655,282; 5,675,944; 5,177,916; 5,255,481; 5,351,451; 5,501,013; and 5,761,946, the teachings of which are herein incorporated by reference. While such flexible spacer frames help alleviate some of the problems encountered with rigid spacer frames, the use of flexible spacer frames in and of themselves may not completely eliminate the edge breakage and vapor and/or gas transmission problems associated with known edge seal and/or IG unit construction.

[0007] Therefore, it would be advantageous to provide an IG unit having a sealant system which reduces or eliminates the problems associated with known spacer frame and adhesive construction and a method of fabricating such an IG unit.

SUMMARY OF THE INVENTION

[0008] An insulating glass unit is provided having a first glass sheet spaced from a second glass sheet by a spacer frame. The spacer frame, preferably a flexible spacer frame, has a first side and a second side, with the first side located adjacent an inner-surface of the first glass sheet and the second side located adjacent the inner-surface of the second glass sheet. A sealant system incorporating features of the invention is provided on each side of the spacer frame to hold the glass sheets to the spacer frame. The sealant system includes a first structural sealant, preferably a thermosetting material, spaced from a second structural sealant, such as another or the same thermosetting material. A moisture barrier or moisture impervious material, preferably a thermoplastic material such as PIB, is located between the first and second structural sealant materials.

[0009] A method is also provided for making and using the sealant system of the invention for an insulating glass unit. A spacer frame is provided between a pair of glass sheets to provide a chamber therebetween. The spacer frame is preferably a flexible spacer frame fabricated by bending or forming a spacer stock. The spacer frame has a base and two spaced apart legs joined to the base to provide a substantially U-shape. The sealant system is applied to the spacer frame, e.g. beads of sealant material are provided onto the outer surfaces of

the spacer frame, e.g. onto the outer surfaces of the legs and optionally onto the outer surface of the base. The sealant system includes a bead of low moisture vapor transmission or moisture barrier material, e.g., a thermoplastic material such as polyisobutylene or hot melt butyl, located between two beads of structural sealant, e.g., a thermoset material such as a silicone containing adhesive. The glass sheets are secured to the spacer frame by the sealant system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a sectional view of an edge assembly of a prior art IG unit;
Fig. 2 is a sectional view of the right side of the edge assembly of Fig. 1 when stress is applied to the prior art IG unit;
Fig. 3 is a sectional view of an edge assembly of an IG unit having a sealant system incorporating features of the invention; and
Fig. 4 is a sectional view of the right side of the edge assembly of Fig. 3 when stress is applied to the IG unit.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] For purposes of the description hereinafter, spatial or directional terms such as "inner", "outer", "left", "right", "back" shall relate to the invention as it is shown in the drawing figures. However, it is to be understood that the invention may assume various alternative orientations and step sequences without departing from the inventive concepts disclosed herein. Accordingly, such terms are not to be considered as limiting.

[0012] A portion of an IG unit 11 having a sealant system 23 incorporating features of the invention is shown in Figs. 3 and 4. The IG unit 11 has a first glass sheet 19 with an inner surface 21 and an outer surface 25. The first glass sheet 19 is spaced from a second glass sheet 20 having an inner surface 22 and an outer surface 24. The distance between the two glass sheets 19 and 20 is maintained by an edge assembly 26 having a spacer frame 28 which is adhesively bonded to the two glass sheets 19 and 20 by the sealant system 23. Although not limiting to the invention, the two glass sheets 19 and 20 may be spaced about a half an inch, more preferably about 0.47 inch (about 1.20 cm) apart to form a chamber 30 or "dead space" between the two glass sheets 19 and 20. The chamber 30 can be filled with an insulating gas such as argon or krypton. A desiccant material 32 may be adhesively bonded to one of the inner surfaces of the spacer frame 28 in any convenient manner. E.g. as shown in Fig. 3 to inner surface 41 of the base 40 of the spacer frame 28.

[0013] The two glass sheets 19 and 20 may be clear glass, e.g., clear float glass, or one or both of the glass sheets 14 and 20 could be colored glass. A functional coating 34, such as a solar control or low emissivity coating, may be applied in any conventional manner, such as MSVD, CVD, pyrolysis, sol-gel, etc., to a surface, e.g., an inner surface, of at least one of the glass sheets 19 or 20.

[0014] The spacer frame 28 itself may be a conventional rigid or box-type spacer frame as is known in the art, e.g. as shown in Fig 1. However, it is preferred that the spacer frame 28 be a flexible-type spacer frame which may be formed from a piece of metal, such as 201 or 304 stainless steel or tin plated steel, and bent and shaped into a substantially U-shaped, continuous spacer frame as described hereinbelow. The spacer frame 28 is adhesively bonded around the perimeter or edges of the spaced glass sheets 19 and 20 by the sealant system 23.

[0015] The spacer frame 28 shown in Figs. 3 and 4 may be formed in conventional manner from a piece of metal, e.g. steel, having a thickness of about 0.010 inch (0.025 cm). The spacer frame 28 includes a base 40 having an inner surface 41, an outer surface 43 and a width of about 0.25-0.875 in (0.64 cm to 2.22 cm). The spacer frame 28 has opposed first and second sides defined by a pair of opposed legs 42 and 44, respectively, which extend from the base 40. Each leg 42,44 has a length of about 0.300 inch (0.76 cm) with a stiffening element 46 having a length of about 0.05 to 0.08inch (0.13 to 0.02cm) formed on the outer end of each leg 42,44. Each stiffening element 46 has a longitudinal axis which extends transverse, e.g. substantially perpendicularly, to the longitudinal axis L of its associated leg 42,44. The spacer 28 is configured such that each leg 42,44 is substantially flexible to provide for movement of the glass sheets 19 and 20 due to pressure or atmospheric changes as shown in Fig. 4 and discussed further hereinbelow. Preferably, each leg 42,44 is sufficiently flexible to be deflectable by at least about 0.5-1.0 degree from the neutral position shown in Fig. 3 in which each plane having one of the legs 42,44 is substantially perpendicular to a plane having the base 40. Each leg 42,44 includes an inner surface 48 facing the interior of the IG unit 11 and an outer surface 50 facing the inner surface 21 or 22 of the adjacent glass sheet 19 or 20. Although it is preferred that the spacer frame 28 be metal, the invention is not limited to metal spacer frames. The spacer frame 28 could be made of a polymeric material, e.g., halogenated polymeric material such as polyvinylidene chloride or fluoride or polyvinyl chloride or polytrichlorofluoro ethylene. The spacer frame 28 should be "structurally sound", meaning that the spacer frame 28 maintains the glass sheets 19 and 20 in spaced relationship while permitting local flexure of the glass sheets 19 and 20 due to changes in barometric pressure, temperature and wind load.

[0016] The sealant system 23 of the invention formed between the outer surface of the spacer frame 28, e.g.

the outer surface 50 of a spacer leg 42,44 and the inner surface 21 or 22 of its associated glass sheet 14 or 20, will now be described. The sealant system 23 is preferably a "triple seal" system utilizing three separate or distinct sealant regions utilizing both structural sealants and a moisture barrier sealant, such as a moisture resistant or low moisture vapor transmission rate (MVTR) sealant. As used herein, the terms moisture barrier, moisture resistant or low MVTR sealant refer to sealants which are impervious or substantially impervious to moisture or moisture vapor. Specifically, the sealant system 23 includes a first structural sealant material 56 located near the outer end of each leg 42,44 and a second structural sealant material 58 spaced from the first structural sealant material 56 and located near the base 40. The structural sealant materials 56 and 58 are both preferably thermosetting materials, i.e. materials capable of becoming permanently rigid when heated or cured, and preferably have a tensile strength of about 200-300 psi at 200 percent elongation in accordance with ASTM D412. The structural sealant materials 56,58 are both preferably one part, hot-applied, chemically curing, silicone modified, polyurethane insulating glass sealant. An example of an acceptable sealant is PRC 590 sealant commercially available from PPG Industries, Inc. of Pittsburgh, Pennsylvania. A low MVTR sealant material 60 is positioned between the two structural sealant materials 56 and 58. The low MVTR sealant 60 preferably has a moisture vapor transmission rate of less than about 0.20 grams per square meter per day as measured on a 0.060 inch film and a gas permeance of less than about 1-3 cubic centimeters per 100 square inches per day, as measured on a 0.040 inch film as defined by ASTM D1434. Examples of an acceptable low MVTR sealant 60 include polyisobutylene (PIB) or hot melt butyl.

[0017] In the preferred embodiment of the invention shown in Fig. 3, the first structural sealant material 56 has a thickness (t) of about 0.015 to 0.025 inch (0.038 - 0.064 cm) and a length (x) of about 0.125 inch (0.318 cm). The low MVTR sealant 60 has a thickness (t) of about 0.015 to 0.025 inch (0.038 - 0.064 cm) and a length (y) of about 0.125 inch (0.0318 cm). The second structural sealant 58 has a length (z) of about 0.090 inch (0.23 cm) and, as shown in Fig. 3, preferably extends across the width of the spacer 28, e.g., extending across the perimeter groove formed by the outer surface 43 of the base 40 and the marginal edges of the glass sheets 19 and 20. This combination of sealants 56, 58 and 60 along with the flexibility of the spacer legs 42 and 44 provides enhanced structural capacity as well as low moisture and gas permeation properties to the IG unit 11.

[0018] As shown in Fig. 4, when stress is applied to the IG unit 11 causing rotation or movement of the glass sheet 19, the structural sealants 56 and 58 ensure that the spacer leg 44 flexes or moves with the glass sheet 19 to help relieve the stress. For example, computer generated finite element analysis was conducted to compare the performance of a rigid, box-type spacer sealed to opposed glass sheets by a dual sealant structure (shown in Figs. 1 and 2) with the performance of a flexible spacer sealed to opposed glass sheets by the triple sealant structure (shown in Figs. 3 and 4). The largest amount of stress, i.e., stretching or pulling force per unit area of the sealant, was found at the inner edge of the edge seal where the peeling force is the greatest. At a glass deflection which yielded a stress of about 500 psi in the dual sealant system, the triple sealant system with the flexible spacer had a stress of only about 150 psi. This lower stress helps prevent premature failure of the sealant system 23 of the invention. Further, the dual sealant system is calculated to have a moisture vapor transmission of about 0.074×10^{-5} gm-in/hr-sq.ft.-inch of mercury (Hg) while the triple sealant system of the invention with a flexible spacer was calculated to have a moisture vapor transmission of about 0.0012×10^{-5} gm-in/hr-sq.ft.-inch of Hg, a reduction by a factor of about sixty four.- Since the MVTR sealant 60 is dammed between the two structural sealants 56 and 58, there is little or no stretching of the MVTR sealant 60 as was common in the prior art.

[0019] A method of fabricating an IG unit 11 incorporating a sealant system 23 in accordance with the invention will now be described. As will be appreciated, the IG unit 11 and spacer frame 28 may be fabricated in any convenient manner, for example as taught in U.S. Patent No. 5,655,282 but as modified as discussed hereinbelow to include the sealant system 23 of the invention. For example, a substrate, such as a metal sheet of 201 or 304 stainless steel having a thickness of about 0.010 inch and a length and width sufficient for producing a spacer frame of desired dimensions, may be formed by conventional rolling, bending or shaping techniques, for example as described in U.S. Patent No. 5,655,282. Although the sealant materials 56,58 and 60 may be positioned on the substrate before shaping, it is preferred that the sealant materials 56,58 and 60 be applied after the spacer frame 28 is shaped. The sealant materials 56,58 and 60 may be applied in any order. The second structural sealant material 58 may be applied with multiple nozzles, e.g., one nozzle applying the second structural sealant material 58 to the side of the spacer 28, i.e., on the outside of the leg 42 or 44, and another nozzle applying additional second sealant material 58 across or on the outer surface 43 of the base 40.

[0020] The IG unit 11 is assembled by positioning and adhering the glass sheets 19 and 20 to the spacer frame 28 by the sealant system 23 in any convenient manner. An insulating gas, such as argon or krypton, may be introduced into the chamber 30 in any convenient manner. Together, the structural sealant material beads act to attach the glass sheets 19,20 to the spacer frame 28. In the practice of the invention, a low moisture permeation and low gas permeation, low modulus, non-structural sealant, such as PIB or hot melt butyl, is contained and

constrained in the space between the two structural sealant beads. Because of the strength and structural nature of the structural sealant beads, the non-structural low MVTR material does not deform to any great extent during loading and therefore maintains its original low moisture and low gas permeation properties.

[0021] It will be readily appreciated by those skilled in the art that modifications may be made to the invention without departing from the concepts disclosed in the foregoing description. For example, although the exemplary embodiment described above utilized two glass sheets attached to the spacer, the invention is not limited to IG units having only two glass sheets but may be practiced to make IG units have two or more glass sheets, as are known in the art. Further, in the preferred embodiment of the invention, the sealant system was used with a spacer frame having a generally U-shaped cross-section; the invention, however, may be used with a spacer having any type of cross-section, e.g. of the type shown in Fig. 1. Still further, the invention was discussed by providing a portion of the sealant system in a channel formed by the outer surface of the base of the spacer frame and inner marginal edge portion of the sheets extending beyond the outer surface of the base. The invention may be practiced by not providing for any sealant in the channel or in the alternative aligning the peripheral edge of each sheet with the outer surface of the base or in another alternative by the outer surface of the base extending beyond the peripheral edges of the sheets. Still further, the layers of the sealant system may be applied or flowed onto the outer surface of the spacer frame in any convenient manner, e.g. one layer, two layers or three layers flowed onto the spacer frame. Accordingly, the particular embodiments described in detail herein are illustrative only and are not limiting to the scope of the invention, which is to be given the full breadth of the appended claims and any and all equivalents thereof.

Claims

1. An insulating glass unit (11), comprising:

   a first glass sheet (19) having an inner surface (21) and an outer surface (25);
   a second glass sheet (20) having an inner surface (22) and an outer surface (24), said glass sheets positioned such that said inner surfaces (21,22) of said glass sheets are facing one another;
   a spacer frame (28) located between said first and second glass sheets (19,20), said spacer frame having a first side and a second side, with said first side located adjacent said inner surface (21) of said first glass sheet (19) and said second side located adjacent said inner surface (22) of said second glass sheet (20); and
   a sealant system (23) connecting said glass sheets (19,20) to said spacer frame (28), said sealant system including a first structural sealant material (56) spaced from a second structural sealant material (58), with a moisture barrier material (60) located between said first and second said structural sealant materials (56,58), wherein said first and second structural sealant materials (56,58) are each thermoset materials and the moisture barrier material (60) is a thermoplastic material.

2. The unit (11) as claimed in claim 1, wherein said structural sealants (56,58) include a chemically curing, silicone modified, polyurethane sealant.

3. The unit (11) as claimed in claim 1, wherein said moisture barrier material (60) has a moisture vapor transmission rate less than about 0.20 gram per square meter per day as measured by on a 0.60 inch (15.24 mm) film as defined by ASTM D1434.

4. The unit (11) as claimed in claim 3, wherein said moisture barrier material (60) has a gas permeance of less than about 1-3 cubic cm per 100 square inches (645 square centimeters) per day as measured on a 0.040 inch (1.016 mm) film as defined by ASTM D1434.

5. The insulating glass unit (11) as claimed in claim 1, wherein said spacer frame (28) has two spaced, substantially flexible legs (42,44) extending therefrom, each leg having a first end, a second end, an inner surface (48) and an outer surface (50), with the outer surfaces of said legs facing said inner surface (21,22) of an adjacent glass sheet (19,20).

6. The unit (11) as claimed in claim 1, wherein each of the structural sealant materials (56,58) has a tensile strength of about 200-300 psi at 200 percent elongation.

7. The unit (11) as claimed in claim 1 or 6, wherein each said thermoset material includes a one part, hot applied, chemically curing, silicone modified, polyurethane sealant.

8. A method of making an insulating glass unit (11), comprising the steps of:

   providing a spacer frame (28) having a first side and a second side;
   forming a sealant system (23) adjacent said first and second spacer frame sides, said forming step practiced by placing a first structural sealant material (56) bead, a second structural sealant material (58) bead and a moisture barrier material (60) bead on said spacer frame

(28), with said moisture barrier material (60) bead located between said first and second structural sealant material (56,58) beads, wherein the first and second structural sealant material are thermoset materials having a tensile strength of about 200-300 psi at about 200 percent elongation in accordance with ASTM D412 and the moisture barrier sealant is a thermoplastic material having a moisture vapor transmission rate of less than about 0.2 gram per square meter per day as measured on a 0.60 inch (15,24 mm) film and a gas permeance of less than about 1-3 cubic cm per 100 square inch (645 square cm) per day as measured on a 0.040 inch (1.016 mm) film as defined by ASTM D1434;
securing a first glass sheet (19) by said sealant system (23) to said first side; and
securing a second glass sheet (20) by said sealant system (23) to said second side.

9. The method as claimed in claim 8, including providing an insulating gas between said fist and second glass sheets (19,20).

10. The method as claimed in claim 8 or the unit as claimed in claim 1, wherein said moisture barrier material (60) is polyisobutylene.

11. The method as claimed in claim 8 or the unit as claimed in claim 4, wherein said moisture barrier material (60) bead has a length of about 0.125 inches (3.175 mm) and a thickness of about 0.020 inches (0.508 mm).

12. The method as claimed in claim 8 or the unit as claimed in claim 4 or 11, wherein said first structural sealant material (56) bead has a thickness of about 0.020 inches (0.508 mm) and a length of about 0.125 inches (3.175 mm).

13. The method as claimed in claim 8 or the unit as claimed in claims 4, 11 or 12, wherein said second structural sealant material (58) bead has a length of about 0.090 inches (2.286 mm).

14. The method as claimed in claim 8, wherein said spacer frame (28) includes a pair of spaced, substantially flexible legs (42,44) interconnected by a base (40) to space said legs from one another and maintain the legs spaced from one another.

15. A sealant system (23) for connecting glass sheets (19,20) to a spacer frame (28) in an insulating glass unit (11), said sealant system comprising:

a first structural sealant material (56) spaced from a second structural sealant material (58), each of the structural sealant materials are thermoset materials having a tensile strength of about 200-300 psi at about 200 percent elongation in accordance with ASTM D412; and
a moisture barrier material (60) located between said first and second structural sealant materials (56,58), the moisture barrier material (60) is a thermoplastic material having a moisture vapor transmission rate of less than 0.20 gram per square meter per day as measured on a 0.60 inch (15.24 mm) film and a gas permeance of less than about 1-3 cubic cm per 100 square inches (645 square cm) per day as measured on a 0.040 inch (1.016 mm) film as defined by ASTM D1434.

16. The system (23) as claimed in claim 15, wherein said first and second structural sealant materials (56,58) are thermosetting materials.

17. The system (23) as claimed in claim 15, wherein said moisture barrier material (60) is a thermoplastic material.

18. The insulating glass unit (11) as claimed in claim 3, wherein the spacer frame (23) in cross section has a first leg (42) and a second leg (44) joined to a base (40) to provide the spacer frame in cross section with a U-shape wherein said first side of said spacer frame (28) is outer surface of said first leg (42) and said second side of said spacer frame (28) is outer surface of said second leg (44) and said first and second legs (42,44) are spaced from and out of contact with one another.

Patentansprüche

1. Isolierglaseinheit (11) enthaltend

eine erste Glasscheibe (19) mit einer Innenfläche (21) und einer Außenfläche (25);
eine zweite Glasscheibe (20) mit einer Innenfläche (22) und einer Außenfläche (24), wobei die Glasscheiben so angeordnet sind, dass die Innenflächen (21,22) der Glasscheiben zueinander weisen;
einen Abstandhalterrahmen (28), angeordnet zwischen der ersten und zweiten Glasscheibe (19,20), wobei der Abstandhalterrahmen eine erste Seite und eine zweite Seite aufweist, wobei die erste Seite neben der Innenfläche (21) der ersten Glasscheibe (19) angeordnet ist und die zweite Seite neben der Innenfläche (22) der zweiten Glasscheibe (20) angeordnet ist; und
ein Dichtsystem (23), das die Glasscheiben (19,20) mit dem Abstandhalterrahmen (28) verbindet, wobei das Dichtsystem ein erstes Struk-

turdichtmaterial (56) enthält, beabstandet von einem zweiten Strukturdichtmaterial (58), wobei ein Feuchtigkeitssperrmaterial (60) zwischen dem ersten und zweiten Strukturdichtmaterial (56,58) angeordnet ist, bei dem das erste und zweite Strukturdichtmaterial (56,58) jeweils wärmehärtbare Materialien sind und das Feuchtigkeitssperrmaterial (60) ein Thermoplastmaterial ist.

2. Einheit (11) nach Anspruch 1, bei der die Strukturdichtmittel (56,58) ein chemisch härtendes, siliconmodifiziertes Polyurethandichtmittel enthalten.

3. Einheit (11) nach Anspruch 1, bei der das Feuchtigkeitssperrmaterial (60) eine Wasserdampfdurchlässigkeitsrate von weniger als etwa 0,20 g/m^2 pro Tag aufweist, wie auf einem 0,60 Zoll (15,24 mm)

- Film gemessen, wie durch ASTM D1434 definiert.

4. Einheit (11) nach Anspruch 3, bei der das Feuchtigkeitssperrmaterial (60) eine Gasdurchlässigkeit von weniger als etwa 1 bis 3 Kubikzentimeter pro 100 Quadratzoll (645 cm^2) pro Tag aufweist, wie auf einem 0,040 Zoll (1,016 mm) - Film gemessen, wie durch ASTM D1434 bestimmt.

5. Isolierglaseinheit (11) nach Anspruch 1, bei der der Abstandhalterrahmen (28) zwei beabstandete, im Wesentlichen flexible Schenkel (42,44) aufweist, die sich davon erstrecken, wobei jedes Bein ein erstes Ende, ein zweites Ende, eine Innenfläche (48) und eine Außenfläche (50) aufweist, wobei die Außenflächen der Schenkel zu der Innenfläche (21,22) einer benachbarten Glasscheibe (19,20) weisen.

6. Einheit (11) nach Anspruch 1, bei der jedes der Strukturdichtmaterialien (56,58) eine Zugfestigkeit von etwa 200 bis 300 psi bei 200-prozentiger Dehnung aufweist.

7. Einheit (11) nach Anspruch 1 oder 6, bei der jedes wärmehärtbare Material ein einteiliges, warm aufgetragenes, chemisch härtendes, siliconmodifiziertes Polyurethandichtungsmittel enthält.

8. Verfahren zur Herstellung einer Isolierglaseinheit (11), enthaltend die Schritte des:

Vorsehens eines Abstandhalterrahmens (28) mit einer ersten Seite und einer zweiten Seite;
Ausbildens eines Dichtsystems (23) benachbart zu der ersten und zweiten Abstandhalterrahmenseite, wobei der Ausbildungsschritt durch Anordnen eines ersten Strukturdichtmaterial (56)-Wulstes, eines zweiten Strukturdichtmaterials (58)-Wulstes und eines Feuchtigkeitssperrmaterial (60)- Wulstes auf dem Abstandhalterrahmen (28) durchgeführt wird, wobei der Feuchtigkeitssperrmaterial (60)-Wulst zwischen dem ersten und zweiten Strukturdichtmaterial (56,58)-Wulstes angeordnet wird, wobei das erste und zweite Strukturdichtmaterial wärmehärtbare Materialien sind mit einer Zugfestigkeit von etwa 200 bis 300 psi bei etwa 200-prozentiger Dehnung gemäß ASTM D412 und wobei das Feuchtigkeitssperrdichtmittel ein thermoplastisches Material mit einer Wasserdampfdurchlässigkeitsrate von weniger als etwa 0,2 g/m^2 pro Tag ist wie auf einem 0,60 Zoll (15,24 mm) - Film gemessen, und einer Gasdurchlässigkeit von weniger als etwa 1 bis 3 Kubikzentimetern pro 100 Quadratzoll (645 cm^2) pro Tag, wie auf einem 0,040 Zoll (1,016 mm) - Film gemessen, wie durch ASTM D1434 bestimmt;
Befestigens einer ersten Glasscheibe (19) durch das Dichtsystem (23) an der ersten Seite und
Befestigens einer zweiten Glasscheibe (20) durch das Dichtsystem (23) an der zweiten Seite.

9. Verfahren nach Anspruch 8, enthaltend das Vorsehen eines Isoliergases zwischen der ersten und zweiten Glasscheibe (19,20).

10. Verfahren nach Anspruch 8 oder Einheit nach Anspruch 1, bei dem oder der das Feuchtigkeitssperrmaterial (60) Polyisobutylen ist.

11. Verfahren nach Anspruch 8 oder Einheit nach Anspruch 4, bei dem oder der der Feuchtigkeitssperrmaterial (60)-Wulst eine Länge von etwa 0,125 Zoll (3,175 mm) und eine Dicke von etwa 0,020 Zoll (0,508 mm) aufweist.

12. Verfahren nach Anspruch 8 oder Einheit nach Anspruch 4 oder 11, bei dem oder der der erste Strukturdichtmaterial (56)-Wulst eine Dicke von etwa 0,020 Zoll (0,508 mm) und eine Länge von etwa 0,125 Zoll (3,175 mm) aufweist.

13. Verfahren nach Anspruch 8 oder Einheit nach Anspruch 4, 11 oder 12, bei dem oder der der zweite Strukturdichtmaterial (58)-Wulst eine Länge von etwa 0,090 Zoll (2,286 mm) aufweist.

14. Verfahren nach Anspruch 8, bei dem der Abstandhalterrahmen (28) ein Paar von beabstandeten, im Wesentlichen flexiblen Schenkeln (42,44) enthält, die untereinander durch eine Basis (40) verbunden sind, um einen Abstand der Schenkel voneinander

zu schaffen und die Schenkel voneinander beabstandet zu halten.

15. Dichtsystem (23) zum Verbinden von Glasscheiben (19,20) mit einem Abstandhalterrahmen (28) in einer Isolierglaseinheit (11), wobei das Dichtsystem enthält:

ein erstes Strukturdichtmaterial (56) beabstandet von einem zweiten Strukturdichtmaterial (58), wobei jedes der Strukturdichtmaterialien ein wärmehärtbares Material ist mit einer Zugfestigkeit von etwa 200 bis 300 psi bei etwa 200prozentiger Dehnung gemäß ASTM D412; und

ein Feuchtigkeitssperrmaterial (60), angeordnet zwischen dem ersten und zweiten Strukturdichtmaterial (56,58), wobei das Feuchtigkeitssperrmaterial (60) ein thermoplastisches Material mit einer Wasserdampfdurchlässigkeitsrate von weniger als 0,20 g/m^2 pro Tag ist, wie auf einem 0,60 Zoll (15,24 mm) - Film gemessen, und eine Gasdurchlässigkeit von weniger als etwa 1 bis 3 Kubikzentimeter pro 100 Quadratzoll (645 cm^2) pro Tag, wie auf einem 0,040 Zoll (1,016 mm) - Film gemessen, wie durch ASTM D1434 bestimmt.

16. System (23) nach Anspruch 15, bei dem die ersten und zweiten Strukturdichtmaterialien (56,58) wärmehärtbare Materialien sind.

17. System (23) nach Anspruch 15, bei dem das Feuchtigkeitssperrmaterial (60) ein thermoplastisches Material ist.

18. Isolierglaseinheit (11) nach Anspruch 3, bei der der Abstandhalterrahmen (23) im Querschnitt ein erstes Bein (42) und ein zweites Bein (44), verbunden mit einer Basis (40) aufweist, um einen Abstandhalterrahmen mit einer U-Form im Querschnitt vorzusehen, bei dem die erste Seite des Abstandhalterrahmens (28) die Außenfläche des ersten Beins (42) ist und die zweite Seite des Abstandhalterrahmens (28) eine Außenseite des zweiten Beins (44) ist, und die ersten und zweiten Schenkel (42,44) voneinander beabstandet und zueinander ohne Kontakt angeordnet sind.

Revendications

1. Unité (11) de vitrage isolant, comprenant:

une première feuille de verre (19) qui présente une surface intérieure (21) et une surface extérieure (25);

une deuxième feuille de verre (20) qui présente une surface intérieure (22) et une surface extérieure (24), lesdites feuilles de verre étant positionnées de telle sorte que lesdites surfaces intérieures (21, 22) desdites feuilles de verre soient tournées l'une vers l'autre;

un cadre d'écartement (28) situé entre ladite première et ladite deuxième feuille de verre (19, 20), ledit cadre d'écartement présentant un premier coté et un deuxième côté, ledit premier côté étant situé en position adjacente à ladite surface intérieure (21) de ladite première feuille de verre (19) et ledit deuxième côté étant situé en position adjacente à ladite surface intérieure (22) de ladite deuxième feuille de verre (20); et

un système de mastic (23) reliant lesdites feuilles de verre (19, 20) audit cadre d'écartement (28), ledit système de mastic comprenant un premier matériau de mastic structurel (56) maintenu à distance d'un deuxième matériau de mastic structurel (58), un matériau (60) de barrière vis-à-vis de l'humidité étant situé entre ledit premier et ledit deuxième matériau de mastic structurel (56, 58), ledit premier et ledit deuxième matériau de mastic structurel (56, 58) étant tous deux des matériaux thermodurcissables et le matériau (60) de barrière vis-à-vis de l'humidité étant un matériau thermoplastique.

2. Unité (11) selon la revendication 1, dans laquelle lesdits mastics structurels (56, 58) comprennent un mastic au polyuréthane modifié par silicone et durcissant chimiquement.

3. Unité (11) selon la revendication 1, dans laquelle ledit matériau (60) de barrière vis-à-vis de l'humidité présente un taux de transmission de vapeur d'humidité inférieur à environ 0,20 gramme par mètre carré et par jour, mesuré sur un film de 15,24 mm (0,60 pouce) de la façon définie par ASTM D1434.

4. Unité (11) selon la revendication 3, dans laquelle ledit matériau (60) de barrière vis-à-vis de l'humidité présente une perméabilité au gaz, mesurée sur un film de 1,016 mm (0,040 pouce) de la façon définie par ASTM D1434, inférieure à environ 1 à 3 cm^3 par jour pour 645 centimètres carrés (100 pouces carrés).

5. Unité (11) de vitrage isolant selon la revendication 1, dans laquelle deux branches (42, 44) maintenues à distance l'une de l'autre et essentiellement flexibles débordent dudit cadre d'écartement (28), chaque branche présentant une première extrémité, une deuxième extrémité, une surface intérieure (48) et une surface extérieure (50), les surfaces extérieures desdites branches étant tournées vers la surface intérieure (21, 22) d'une feuille de verre (19,

20) adjacente.

6. Unité (11) selon la revendication 1, dans laquelle chacun des matériaux de mastic structurel (56, 58) présente une résistance à la traction d'environ 200 à 300 psi à un allongement de 200 pourcent.

7. Unité (11) selon la revendication 1 ou 6, dans laquelle chacun desdits matériaux thermodurcissable comprend un mastic de polyuréthane en une pièce, appliqué à chaud, durcissant chimiquement et modifié par silicone.

8. Procédé de fabrication d'une unité (11) de vitrage isolant qui comprend les étapes consistant à:

prévoir un cadre d'écartement (28) qui présente un premier côté et un deuxième côté;
former un système de mastic (23) en position adjacente audit premier et audit deuxième côté du cadre d'écartement, ladite étape étant réalisée en plaçant un premier boudin de matériau de mastic structurel (56), un deuxième boudin de mastic structurel (58) et un boudin de matériau (60) de barrière vis-à-vis de l'humidité sur ledit cadre d'écartement (28), ledit boudin de matériau (60) de barrière vis-à-vis de l'humidité étant situé entre ledit premier et ledit deuxième boudin de matériau de mastic structurel (56, 58), ledit premier et ledit deuxième matériau de mastic structurel étant des matériaux thermodurcissables qui présentent une résistance à la traction d'environ 200 à 300 psi à un allongement d'environ 200 pourcent conformément à ASTM D412 et le mastic de barrière vis-à-vis de l'humidité étant un matériau thermoplastique qui présente un taux de transmission de vapeur d'humidité inférieur à environ 0,2 gramme par mètre carré et par jour, mesuré sur un film de 15,24 mm (0,60 pouce) et une perméabilité au gaz inférieure à environ 1 à 3 cm cube par 645 cm carrés (100 pouces carrés) par jour, mesuré sur un film de 1,016 mm (0,040 pouce) de la façon définie par ASTM D1434;
fixer une deuxième feuille de verre (19) sur ledit premier côté par ledit système de mastic (23); et
fixer une deuxième feuille de verre (20) sur ledit deuxième côté par ledit système de mastic (23).

9. Procédé selon la revendication 8, qui comprend l'étape qui consiste à fournir un gaz isolant entre ladite première et ladite deuxième feuille de verre (19, 20).

10. Procédé selon la revendication 8 ou unité selon la revendication 1, dans lesquels ledit matériau (60) de barrière vis-à-vis de l'humidité est le polyisobutylène.

11. Procédé selon la revendication 8 ou unité selon la revendication 4, dans lesquels ledit boudin de matériau (60) de barrière vis-à-vis de l'humidité présente une longueur d'environ 3,175 mm (0,125 pouce) et une épaisseur d'environ 0,508 mm (0,020 pouce).

12. Procédé selon la revendication 8 ou unité selon la revendication 4 ou 11, dans lesquels ledit premier boudin de matériau de mastic structurel (56) présente une épaisseur d'environ 0,508 mm (0,020 pouce) et une longueur d'environ 3,175 mm (0,125 pouce).

13. Procédé selon la revendication 8 ou unité selon les revendications 4, 11 ou 12, dans lesquels ledit deuxième boudin de matériau de mastic structurel (58) présente une longueur d'environ 2,286 mm (0,090 pouce).

14. Procédé selon la revendication 8, dans lequel ledit cadre d'écartement (28) comprend une paire de branches (42, 44) maintenues à distance l'une de l'autre, essentiellement flexibles, reliées par une base (40) pour écarter lesdites branches l'une de l'autre et maintenir les branches à distance l'une de l'autre.

15. Système de mastic (23) pour relier des feuilles de verre (19, 20) à un cadre d'écartement (28) dans une unité (11) de vitrage d'isolant, ledit système de mastic comprenant:

un premier matériau de mastic structurel (56) maintenu à distance d'un deuxième matériau de mastic structurel (58), chacun des matériaux de mastic structurel étant un matériau thermodurcissable qui présente une résistance en traction d'environ 200 à 300 psi à un allongement d'environ 200 pourcent, conformément à ASTM D412; et
un matériau (60) de barrière vis-à-vis de l'humidité situé entre ledit premier et ledit deuxième matériau de mastic structurel (56, 58), le matériau (60) de barrière vis-à-vis de l'humidité étant un matériau thermoplastique qui présente un taux de transmission de vapeur d'humidité inférieur à environ 0,2 gramme par mètre carré et par jour, mesuré sur un film de 15,24 mm (0,60 pouce) et une perméabilité au gaz inférieure à environ 1 à 3 cm cube par 645 cm carrés (100 pouces carrés) par jour, mesuré sur un film de 1,016 mm (0,040 pouce) de la façon définie par ASTM D1434.

16. Système (23) selon la revendication 15, dans lequel ledit premier et ledit deuxième matériau de mastic structurel (56, 58) sont des matériaux thermodurcissables.

17. Système (23) selon la revendication 15, dans lequel ledit matériau (60) de barrière vis-à-vis de l'humidité est un matériau thermoplastique.

18. Unité (11) de vitrage isolant selon la revendication 3, dans laquelle le cadre d'écartement (23) présente en section transversale une première branche (42) et une deuxième branche (44) reliées à une base (40) pour fournir un cadre d'écartement de section transversale en forme de U, dans lequel ledit premier côté dudit cadre d'écartement (28) forme la surface extérieure de ladite première branche (42) et ledit deuxième côté dudit cadre d'écartement (28) forme la surface extérieure de ladite deuxième branche (44), ladite première et ladite deuxième branche (42, 44) étant maintenues à distance l'une de l'autre et n'étant pas en contact l'une avec l'autre.

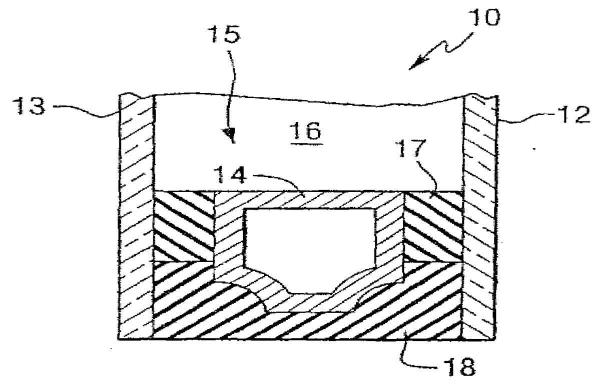

FIG. 1
PRIOR ART

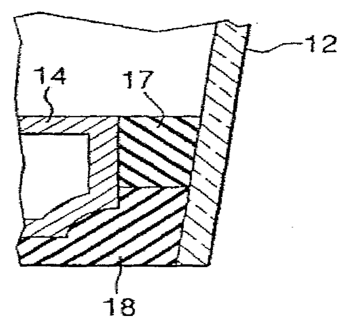

FIG. 2
PRIOR ART

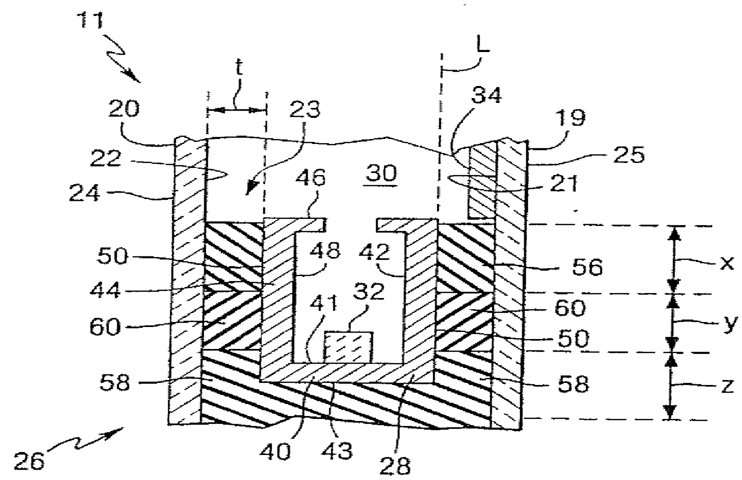
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FIG. 3

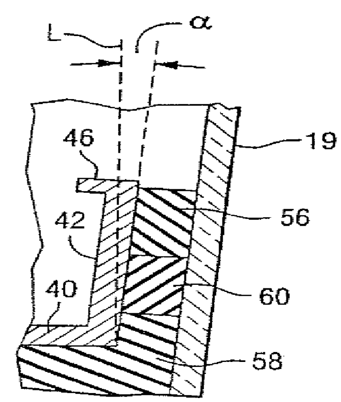
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FIG. 4